



## METHOD FOR FOLDING TIRE BELT

Clean Version

### Technical Field

This is a division of application Serial No. 09/510,779 Tire Belt Folding Drum  
5 filed February 23, 2000. This invention relates to a tire breaker folding drum and  
method where a wide breaker ply is applied to a cylindrical drum with the leading and  
trailing ends spliced together. Then a narrow breaker ply is wrapped around the wide  
breaker ply and its ends spliced. The exposed overlap side edges of the wide breaker  
ply are then folded up over the narrow breaker ply along the side edges of the narrow  
10 breaker ply.

### Background of the Invention

Heretofore ply turn-ups have been made by two bladders positioned at each edge  
such as those shown in U.S. Patent No. 4,427,473. In U.S. Patent No. 5,116,449, a  
15 single bladder at each edge has been used with an outboard turnover cage to provide the  
turn-up. In each of these cases, the ply side edges are carried by the bladders resulting  
in an uncertain condition of the ply side edges after the turn-up is completed.

A breaker forming apparatus without a bladder is also shown in U.S. Patent No.  
4,063,987 where a plurality of folding segments are movable radially and axially  
20 without a bladder to fold the overlap side edges of the wide breaker ply over the side  
edges of the narrow breaker ply. This apparatus requires radially movable segments to  
hold the breaker material in place during the folding operation in the event the ply  
material sticks to the folding segments.

### Summary of the Invention

25 The present invention provides a drum having a plurality of circumferentially  
spaced apart turn-up modules positioned at the edges of the drum. Each of the modules  
has a nosepiece movable axially of the drum from an outer position having the same  
diameter as the diameter of the drum to an inner position overlapping one of the edges  
of the drum. A spring-loaded belt is wrapped around the nosepiece and supports the  
30 wide breaker ply overlap side edge when the wide breaker ply is applied. After the  
narrow breaker ply has been applied, each nosepiece is moved to an inner position  
overlapping the drum edge and carries the wide breaker ply overlap side edge over the  
side edge of the narrow breaker, pressing the overlap side edge against the narrow

breaker ply. After turn-up of the wide breaker ply overlap side edge, the nosepiece is moved axially outward and the belt is peeled off the breaker so as not to distort or stretch the material. The turn-up modules are mounted on a plurality of drum segments spaced circumferentially around the drum and are retractable with the segments for  
 5 removal of the folded breaker package.

In accordance with one aspect of the invention there is provided a method of building a folded breaker on a tire building drum having a plurality of drum folding modules at spaced apart edge positions circumferentially of the drum with each module having a belt with a first belt end fastened to the module and a second belt end fastened  
 10 to an axially movable nose member comprising:

- a. wrapping a wide breaker ply around the drum including the first belt end of each belt fastened to the module and splicing a leading end and a trailing end of said wide breaker ply together,
- b. wrapping a narrow breaker ply having a width less than the width of the  
 15 wide breaker ply around the wide breaker ply exposing an overlap edge of the wide breaker ply at each edge of the wide breaker ply and splicing a leading end and a trailing end of the narrow breaker ply together and,
- c. folding each overlap edge of said wide breaker ply over each side edge of the narrow breaker ply by moving the belt carrying each overlap edge over each side  
 20 edge of the narrow breaker ply by moving each nose member axially inward over each side edge of the narrow breaker ply.

In accordance with another aspect of the invention there is provided a tire building drum assembly for folding edges of a wide breaker ply over edges of a narrow breaker ply wrapped around the wide breaker ply comprising a plurality of  
 25 circumferentially spaced drum segments characterized by a center module mounted on each of the drum segments, a folding module mounted on each of the segments at each end of the center module, each folding module having a nosepiece movable axially of the drum from an axially outer position having the same diameter as the diameter of the center module to an axially inner position overlapping the center module, a folding belt  
 30 wrapped around each nosepiece with an axially inner end fastened to the center module and an axially outer end connected to a spring means on the nosepiece for maintaining tension in the belt providing a support for an overlap edge of the wide breaker ply in the

axially outer position of the nosepiece and providing for sliding movement of the belt over the nosepiece upon axial movement of the nosepiece to the axially inner position for folding each overlap edge of the wide breaker ply over each edge of the narrow breaker ply.

## 5 **Brief Description of the Drawings**

Fig. 1 is an elevation of a breaker-folding drum embodying the invention with the lower center modules and folding modules broken away to show the hub assemblies.

Fig. 2 is a sectional view of the drum and a folding module taken along the plane of line 2-2 in Fig. 1.

10 Fig. 3 is an enlarged view of one of the folding modules in the retracted condition.

Fig. 4 is a view like Fig. 3 with one of the folding modules in the folding position.

## **Detailed Description of the Invention**

15 Referring to Figs. 1 and 2, a breaker folding drum assembly 10 is shown having circumferentially spaced drum segments 12 arranged radially around the circumference of the drum. Two axially spaced hub assemblies 14 and 16 are positioned symmetrically about a lateral centerline A-A of the drum assembly 10. A manually operated acme screw with symmetrical left and right hand threads (not shown) engages  
20 nuts mounted on the inner set of hub assemblies 14 and 16 so that as the screw is rotated the hub assemblies and attached folding modules 18 move symmetrically about the lateral centerline A-A of the drum assembly 10.

Each of the hub assemblies 14 and 16 has circular hubs 20 and 22, with each hub of the assemblies 14,16 having a set of radially extending bushings 24. There is one  
25 bushing 24 for each of the drum segments 12. An inner shaft 26 is inserted into the corresponding bushing 24 of the inner circular hubs 20 and 22 and each of the shafts is attached to one of the folding modules 18. The hub assemblies 14 and 16 and shafts 26 provide the fold width setting for the drum segments 12. In the embodiment shown there are forty drum segments 12, however, this may be adjusted depending upon the  
30 size of the drum assembly 10 and the breaker package to be folded.

In addition to the drum segments 12, center modules 28 are mounted on the inner shafts 26 and interlock with the folding modules 18 at each end of the drum assembly

10. The center modules 28 are replaceable and the folding modules 18 can be adjusted for the desired folding width W shown in Fig. 2. Holes (not shown) may be provided in the center modules 28 and folding modules 18 in communication with the source of vacuum to help hold the breaker stock B on the drum segments 12.

5 Referring to Figs. 3 and 4, each folding module 18 includes a base piece 30, a relatively thin nosepiece 32, a belt member 34 and a spring assembly 36 attached to the belt member at one end and mounted on the nosepiece. The other end of the belt member 34 is attached to the base piece 30 by a bracket 39. The belt member 34 is wrapped around the leading end of the nosepiece 32 and lays flat across the top surface  
10 of the nosepiece. In the retracted position shown in Fig. 3, the folding module 18 presents a flat horizontal surface S. Part of this surface S consists of the radially outer surface of the base piece 30, and the other part consists of the belt member 34 disposed on top of the nosepiece 32 as shown in Fig. 3. The line of contact X where the belt member 34 is attached to the base piece 30 by bracket 39 is where the folding will  
15 occur.

Diameter adjustment may be provided by linear bearings for each end of each drum segment 12. Bearing blocks of the linear rails are attached radially on a common disk. The linear rails move radially within the bearing blocks to provide diameter adjustment. The drum segments 12 are attached to brackets on the linear rails so that  
20 each of the drum segments is supported by one linear rail at each end. Inflatable bladders (not shown) may be provided to move all of the segments diametrically outward when air pressure is applied. The limit of travel is provided by a control ring, which contacts the blocks mounted on the linear rails. This determines a specific working diameter of the drum assembly 10. The control rings are replaceable for  
25 different building diameters. Other methods of diameter adjustment may be provided, such as using a rotating disk with a spiral slot wherein elements on the linear rails engage the spiral slot and the drum diameter maybe adjusted by rotating the disk.

In operation the drum assembly 10 is adjusted to the desired folding width W and expanded to the building diameter. The wide breaker ply 42 is wrapped around the  
30 breaker folding drum assembly 10 and a leading end and a trailing end spliced. Next, a narrow breaker ply 44 is wrapped around the wide breaker ply 42 and a leading end and a tracking end spliced. Internal air motors may be actuated causing the outer hubs 24 to

move in towards the centerline A-A of the drum assembly 10. The hubs 24 move each nosepiece 32 towards the centerline A-A of the drum assembly 10. The hubs 24 carry the nosepieces 32 on the folding modules 18 towards the centerline A-A of the drum assembly 10 by movement of the connecting shafts 26. Beveled surfaces 45 and 46 on the base piece 30 contact corresponding beveled surfaces 48 and 49 on the nosepiece 32 as the nosepiece moves axially inward and to maintain the nosepiece surface at an equal distance from the axis O-O of the drum assembly 10. This minimizes stretching of the plies during the folding process. The belt members 34 which are wrapped around the nosepiece move axially inwards and over the base piece causing the overlap edges of the wide breaker ply 42 to begin folding over the narrow breaker ply 44. During this movement there is no relative motion between the belt member 34 and the wide breaker 42 since all of the sliding action takes place between the nosepiece 32 and the belt member 34. When the nosepiece 32 completes the axially inward motion to the position shown in Fig. 4, the fold is completed. The direction of the air motors is then reversed wherein the outer hub assembly 16 moves axially outward and carries the folding modules 18 to the original positions shown in Fig. 3. During this movement each belt member 34 is peeled off each folded wide breaker ply 42 and returned to the position shown in Fig. 3.

Subsequent tire building operations may then be performed on the drum assembly 10, after which the drum assembly may be collapsed allowing the breaker tread package to be removed from the drum assembly.

While a certain representative embodiment and details have been shown for the purpose of illustrating the invention, it will be apparent to those skilled in the art that various changes and modification may be made therein without departing from the scope of the invention.

Having thus described the invention, it is now claimed: